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Before the Memory Fades: Measuring Long Term Memory in Older Adults

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Abstract: *An instrument was designed to measure visual memory span, a common form of memory used by adult learners. The instrument tested 239 older adults, using color photographs of household objects, which were later recalled. A number of significant variables were found and the instrument is believed suitable for examining the efficacy of adult instructional methods.*

The Problem

One of the universal issues among older adults is the performance of their memory because it is essential to learning and integral to their quality of life. What can older adults reasonably expect from their memory? Older adults comprise one of the fastest growing populations in the United States. In 1890 3% of the population was 80 years of age, by 2010 approximately 30% of the population is expected to reach 80 years (Spiriduso, 1995). Additionally there is an emerging awareness in education and the new field of cognitive neuroscience that knowing more how the adult learner learns can be of significant benefit to all persons. This represents an interweave of adult education, psychology and the neurosciences. However, Merriam and Cunningham (1989) observed there was a distinct lack of normed performance data on how well older adults could learn. The performance of older adult's memory and their ability to learn new information may significantly affect how well they live and may determine whether they will require assistance in daily tasks or be institutionalized. Having greater control over their lives may slow the effects of aging, lengthen the life span as well as the quality of it (LeFrancois, 1996).

After an exhaustive search, there appeared to be no suitable instrument for measuring what a healthy, older adult could recall from realistic stimuli, necessitating the development of an instrument.

Purpose

The purpose of the correlational study was to design an instrument to effectively measure how much could be recalled from a visual display (*visual memory span*) by older adults and that could be correlated with factors that may influence learning. Many instruments were reviewed. General memory tests and tests specifically designed to measure

older adult memory were examined as well as drawing completion tests. A significant problem with existing instruments was that most were designed to detect mental impairment and not the performance of a healthy adult learner. Most instruments measured non-visual forms of memory and examined only the very brief short-term or working memory. While problems of immediately forgetting something may represent a significant short-term memory problem, many of these are apparently problems of attention, not memory (Green, 1999). Another potentially serious but less investigated problem is how much information the adult learner can recall later (*long-term memory span*). The majority of the information that we acquire from birth through death is done visually. No instruments were suitable for measuring visual memory span in older adults. An appropriate instrument would have an older adult learner engaged in a simple visual learning task with meaningful stimuli, followed by a recall task after a delay of minutes, not seconds as in most other memory instruments. As a consequence of the belief that most learning is done visually with meaningful information (Kosslyn, 1994; Matlin, 1994), the selected visual stimuli were taken from a pool of color photographs of real, common household objects and not abstract visual patterns. A screening committee of older adults selected the color photographs in several stages. All the images could be instantly recognized by name and were culturally common to the rural American west. Data were correlated with the health-related and demographic variables.

Design

A preliminary instrument, designed to accommodate the older adult's eyesight and familiarity with the photographs of household objects, was developed and validated through a series of pilot studies.

The 239 adults, aged 55 to 94 and living in the rural areas, were tested individually. The instrument was a single black display board, 20 x 30 inches, with 24 easily seen color photographs, which were viewed all at one time for a period of one minute. The learning task consisted of viewing the instrument and recalling the pictures ten minutes later.

Measuring memory span generally refers to what can be immediately recalled after a brief exposure to non-meaningful stimuli. This investigation utilized meaningful photographic images, which were reported back to the investigator in a written (semantic) form. To be more precise, the instrument measured *semantic visual memory span*. In order to be able to return the larger educational problem of measuring instructional efficacy in the older learner, the instrument considered several fundamental questions: What was the estimate of reliability and validity of the instrument; What were the relationships among age, opinion about their health, blood pressure, depression, activities, education, income, gender and position of the images on the display with visual memory span? The results were both predictable and surprising.

Findings

The data were analyzed using SPSS 6.1 Macintosh version. One of the issues of this investigation concerned the internal consistency of the instrument by estimating the reliability and validity.

Internal Consistency

For this instrument, internal consistency may be viewed as an estimation of how similar the items are in difficulty to recall. On measure of internal consistency may be calculated by a procedure known as Cronbach's alpha. A moderately low value of 0.549 was obtained.

Construct Validity

To establish construct validity, evidence is obtained indirectly. The visual memory span construct was first tested with a bivariate correlation with a type of intelligence test that uses drawings known as the TONI 3 (Brown, Sherbenou & Johnsen, 1997) and was found to have a low correlation of 0.23 ($p < .01$). This suggested that the instrument may not have measured nonverbal intelligence. Factor analysis was also employed, and no single photograph characterized the construct. In a third evaluation, a clear pattern in the amount recalled was clearly demonstrated (See Figure 1).

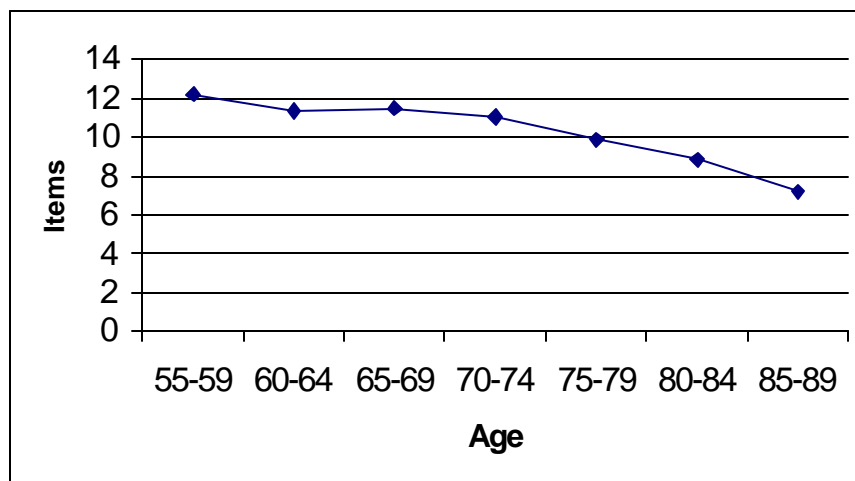


Figure 1. Means of Visual Memory Span with five year increments in age

Health Variables

Age produced a moderate correlation with visual memory span ($-0.36, p < .05$) where it appears that the older adult learners tend to recall fewer photographic items. The mean recall was 10.7 items. Starting at age 55 with a mean of 12.18, there was a steady decline to 7 photographic items in the very oldest adults, representing a 43% drop in recall (See Table 1).

No correlations were found between health opinion, blood pressure and depression. When older adults rated their health on a one to ten scale, with ten being considered excellent and one being poor health, no correlation was found with visual memory span. Blood pressure was clinically measured for two groups, first with the entire sample of adults and then those with high blood pressure (hypertension). Neither group demonstrated a correlation with visual memory span and was surprising because various studies (Elias, et al., 1990; Eisdorfer,

1983; Light, 1975) suggested a relationship between blood pressure and cognitive function.

Depression has been known to affect cognitive function. Of 237 subjects, only 18 demonstrated mild to moderate depression as measured by the Beck Depression Inventory II (BDI II). No correlation for either group was found with visual memory span, indicating no relationship between depressed subjects and visual memory span.

The level of the participant's physical and social activities was also surveyed and appeared to have no relationship with the total number of activities, but a small significant correlation was found with non-physical activities ($0.19, p < .05$). An expected positive correlation with physical activities and visual memory span was not observed. For all activities older adults had a mean of 9.8 and a mean of 6.01 for social activities. Physical activities produced a mean of 3.78.

Table 1. Summary of Means of Visual Memory Span Across Age Levels

Age	<u>n</u>	<u>M</u>	<u>SD</u>
55-59	34	12.18	3.0
60-64	45	11.35	3.2
65-69	39	11.46	2.9
70-74	51	11.00	3.16
75-79	47	9.83	3.37
80-84	14	8.86	2.77
85-89	6	7.17	2.64
90-94	3	7.00	4.3

Non-Health Variables and Visual Memory Span

When different levels of education were correlated with visual memory span significant differences were found. Adults with less than a high school degree (12 years) recalled significantly fewer images ($M = 8.57$). Additionally, adults with incomes below

\$10,000 recalled significantly less than the overall mean, however the sample was small ($n = 9$) and should be interpreted with caution.

As noted earlier under construct validity, a low, but significant correlation with visual memory and nonverbal intelligence was observed when meas-

ured by the TONI 3, suggesting the instrument was probably measuring something other than just non-verbal intelligence.

In respect to gender and visual memory it was found that women demonstrated a significantly greater recall for the photographic items than men when analyzed by a t-test. Women recalled a mean of 11.36 items and men a mean of 9.65 items.

A final variable considered the location in which the images were placed on the display and their relationship to visual memory span. In an unanticipated finding, it was discovered that the top two rows of images and those in the center were substantially better remembered than images along the edges or the bottom half of the display when analyzed by using a paired t-test. The adjusted t-values ranged from 3.73 to a very high 13.44.

Conclusions

The instrument's low internal consistency suggests that some items are more difficult to recall than others and was not unexpected when considered from the perspective that some items might have greater meaning because of familiarity. The instrument does appear to measure a form of commonly used long-term memory span as indicated by the clear pattern of decline. The low correlation with nonverbal intelligence suggests that the instrument is not another measure of intelligence. Adults of retirement age can expect to see a progressive decline in recall performance. Adult's opinion of their health did not have any predictive value. The few numbers of depressed subjects involved in the study was not surprising in that depressed people tend not to participate in such voluntary studies. The interacting variables of education, income and health appeared to have a slight positive relationship with semantic visual memory span though less pronounced than in other studies (Rowe & Kahn, 1998). It may suggest that greater education levels could provide greater opportunity to have higher income and subsequent increased ability to maintain better health care. The social activities, engaged in by adult learners produced a significant low positive correlation, however, the lack of any correlation for physical activities with memory performance was unanticipated in light of the MacArthur studies reported by Rowe and Kahn (1998). Women may have recalled more than men because in post interviews the adults indicated that many of the images were considered "feminine"

household objects and possibly more meaningful to women. The greater the personal meaningfulness of information, the more likely it will be remembered (LeDoux, 1996; Ormrod, 1995). Photographs in the top and center of the display were much better recalled than those along the edges and bottom. It is unclear whether this unexpected finding is an artifact of the test or related to western reading styles.

Implications

1. The instrument can be used as a tool to measure semantic visual memory across the life span and provide developmental information on the adult learner. From subsequent studies, it is now known that semantic visual memory span peaks somewhere between ages 18-55, however, at what age the adult learners attains the maximum recall ability remains uninvestigated. By knowing when to expect the maximum performance, instructional and performance expectations may be appropriately adjusted.
2. Most significantly, the instrument is adaptable for investigating the efficacy of instructional methodologies. This will permit investigations into a tremendous educational void of knowing how much information is still available from memory months after the instruction ceases, something only currently guessed at in all levels of education.
3. Health factors such as physical activity and blood pressure might not have a substantial effect on long term memory. This may confuse what adult learners should do to maintain a healthy mind. This study suggested the correlation of physical activity with cognitive performance was low. However, the MacArthur studies measured different forms of cognitive abilities. This should be investigated further to clarify what the relationships are between health and memory.
4. The phenomenon of information overload is experienced by virtually all life long learners in technologically complex societies. Advances in mathematical theory for complex systems, such as chaos and complexity theory may permit researching the overload phenomenon in the human mind and educational systems. Being able to ascertain more precisely the conditions when information overload is about to occur may provide predictability, which would be of con-

siderable value to the public as well as to educators.

5. The instrument design is potentially a powerful research tool. It provides a platform for a broad spectrum of investigations regarding life long learning and related memory issues whose principle can be used across cultures.

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